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COMPLETE SPECIFICATION.

Improvements in or relating to Surgical Injecting Syringes.

I, JULES COURNAND, Dental Surgeon, of 28, Avenue de l'Opera, Paris, France, do hereby declare the nature of this invention, and in what manner the same is to be performed, to be particularly described and ascertained, in and by the following statement:—

- 5 This invention relates to a syringe that has a piston which is operated by a mechanical device and by means of which a progressive quantity of an anesthetic liquid for example that may if necessary be graduated can be injected at the desired place and at the required moment. This improved syringe can be used in any case of hypodermic injection and particularly in dental operations.
- 10 This syringe arrangement can be applied without modification to the "Astra" and "Imperial" syringes now in use.

For dental operations as carried out at the present time a hypodermic injection is effected in two stages, the first comprising the introduction and placing of the needle, the second the injection of the whole or portion of the contents of the syringe.

For the first phase the barrel of the syringe is conveniently held like a pencil, between the thumb, the forefinger and the middle finger.

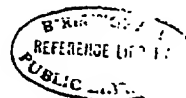
- For the second phase the body of the syringe is held like a cigar between the middle finger and the forefinger which are placed on the two grips arranged at the end of the barrel of the syringe, in order to enable a thumb placed on the piston rod and acting thereon to apply pressure.

- The changes of position effected by the fingers in order to pass from the first to the second stage are frequently attended with difficulty, because the patient may move and the incommoded operator cannot perform that operation as precisely and delicately as required, particularly in the case of diploic and regional punctures, and when the needle is mounted on a bent rod, a rod that is rendered necessary for reaching a part of the buccal cavity that is not easily accessible, or is inaccessible with a straight needle. Consequently the needle may come out of the tissues or break in them.

- 30 In the second phase the syringe is not well placed for effecting a long pressure and at the same time following the instinctive resistant movements of the patient.

- The resistance presented by the tissues to the penetration of the injected liquid, sometimes necessitates a powerful action of the thumb, nay even of the palm of the hand, and it is not infrequently observed that there is a sudden relaxation of the resistance indicating a laceration of the tissues by the powerful pressure of the liquid, giving rise to traumatic accidents which are painful and serious. But independently of these traumatic accidents there is reason for fearing accidents of a toxical kind in consequence of the diffusion over a large surface owing to the sudden irruption into the circulating stream of a large quantity of anesthetic whereas it ought to be injected into a very circumscribed space, and very gently that is to say progressively so as to proportion the quantity of the anesthetic to the susceptibility of the patient. Finally a sudden rush of liquid under powerful pressure causes intolerable pain owing to the fact
- 45 that the tissues are already excessively distended through the inflammation.

[Price 8d.]



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Injectations into the diploe and punctures for regional anæsthesia likewise require a very precise accuracy of position for the syringe.

These practical necessities show the advantage:—

1st of holding the syringe in the position for the first stage so as to be always ready to follow the patient in his instinctive resistant movements, because in that position the syringe is well in hand.

2nd of injecting the liquid very slowly and progressively proportionally to the susceptibility of the patient in order to prevent the liquid from being suddenly diffused in the tissues.

The syringe with automatic progressive action that constitutes the present invention ensures these advantages.

Fig. 1 is a longitudinal section, the piston rod not being shown in section.

Fig. 2 is an end view of the top, the milled nut that is at the end of the rod being removed.

Fig. 3 is a transverse section through $x-x$ in Fig. 1 showing the connection between the rod-operating mechanism and the end A of the casing of the flexible shaft.

Fig. 4 shows the end A of the casing of the flexible shaft.

The cylindrical body 1 of the syringe which is of the usual form is provided with an external nipple 2, through which the needle 3 which may either be straight or bent runs. This needle is secured tightly and firmly by means of the cap 4 screwed on to this nipple.

In this body 1 the piston is moved automatically and very slowly and forces into the needle 3 the anæsthetic, or other liquid contained in the body 1 and which is to be injected into the tissues.

Into the body 1 opposite the nipple 2 a small box 5 is screwed which contains the mechanism for operating the piston rod 6 of the syringe.

This mechanism consists of an endless screw 7 fixed on a shaft 8 that projects from the box 5 and a helicoidal wheel 9 with a hub 10 that is screw-threaded to suit the pitch of the screw-thread of the piston rod 6. The external cylindrical side of this hub is held in the box 5 concentrically to the axis of the rod 6 by means of two discs 11 and 12 attached one to the bottom of the box 5, the other to the interior surface of its cover 13. On to this cover a sleeve 15 is fixed by means of screws 14. The sleeve has a bottom 16 in which an opening is drilled which is partially circular at 17 of and partially rectilinear at 18 opposite flat parts 19 of the piston rod 6 which runs freely through it. This opening acts as a guide for the rod, and prevents it from turning. Beyond the bottom 16 the piston rod is furnished with a milled nut 20 fastened on to it.

The piston rod is screw-threaded over the greater part of its length, a part of the screw-threaded portion being removed through two parallel flat surfaces formed on this rod. The flat surfaces 19 which surmount the screw-threaded part 6 are graduated for the purpose of ascertaining the extent to which the rod is pushed into the cylindrical body 1. To the cylindrical end 21 of the rod a piston, for example metallic, is attached, which has one or two peripheral grooves 23 as may be required. The cylindrical nipple 21 is lodged freely in the corresponding hollow of the piston 22 and a pin 24 connects this nipple with the piston 22. This non-rigid arrangement of the piston on its rod is intended to enable the piston to move to a slight extent in the cylindrical body 1 so as to prevent the wedging of the piston against the inside of the body 1, which might happen in consequence of the slight play existing between the gearings 7 and 9.

One of the novel features of this syringe, provided with a mechanically operated piston consists in the arrangement whereby the shaft 8 that controls the mechanism is in a plane parallel to the longitudinal axis of the syringe and is arranged perpendicularly to that axis.

This arrangement is very important for during use the syringe is held between the middle finger and the fore-finger placed at the height of the box 5 on its projecting surfaces, so that the end A of the casing of the rotary flexible shaft

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of the electric motor for example, connected firmly with the shaft 8 that controls the syringe mechanism, partially supports this syringe and thus relieves the hand of the operator which is in no way incommoded by the flexible shaft, whilst it moves the syringe in any direction and the hand does not impede the rotary shaft
5 of the flexible driving device.

The firm though easily removable connection between the end of the flexible driving device and the operating shaft 8 is effected in the following manner: A sleeve 25 enlarged at the base at 26 is mounted loosely on the ring 27 placed at the point where the shaft 8 projects from the box 5. On the sleeve 25 a screw 28
10 is placed between the box 5 and the ring 27. This screw prevents the sleeve rotating loosely or the ring 27 from separating therefrom. The end A containing the flexible shaft is provided with a right angle gear as is common in dental drills and has a hollow driving member at the end which is adapted to engage the shaft 8. The end A containing the rotary flexible shaft is placed opposite
15 an opening 29 in the sleeve 25 then slid into place so that the shaft 8 engages the hollow driving member and the end of the shaft projects from the opposite end. At this moment a plate 30 turning around the rivet 31 of the end A is pushed towards the shaft in order that its catch 32 may lodge in the annular groove 33 in the end of the shaft 8. This having been effected an angular piece 34
20 pivoted at 35 on the sleeve 25 is turned down on the end A so that its pin 36 bears on the plate 30 and prevents it from coming out. This coupling of the end A and of the shaft 8 enables the syringe to be operated by the flexible shaft irrespective of any movement of the operator's hand, and at the same time allows complete mobility in every direction for the syringe without impeding the normal
25 rotation of the flexible shaft and the operating shaft 8.

The rotation of the shaft 8 is transmitted to the endless screw 7, to the wheel 9, and to its hub 10, causing the screw-threaded part of the piston-rod of the syringe to move forwards and the piston 22 to force the liquid contained in the barrel into the needle 3.

The syringe filled with liquid to be injected being connected, as just stated, to the end A of the casing of the flexible shaft, the latter being not yet set in rotation, the said syringe held between the third finger and the fore-finger which are placed on the projecting surfaces of the box 5, the operator puts the point of the needle 3 in the precise spot in the tissues where the anesthetic or other liquid
35 is to be injected, without moving the hand but if necessary supporting the last two fingers of the hand against the patients' teeth in order that the operator's hand may easily follow the instinctive resistant movements of the patient without the operator having to fear that the needle may move and come out of the tissues, sets the flexible shaft in rotation which causes a rotation of the wheels 7 and 9
40 and the hub 10 and the piston to force the liquid slowly and progressively into the needle and the tissues. By stopping the rotation of the shaft of the flexible device at the required moment the injection is stopped.

Instead of being entirely of metal the piston 22 may be lined with asbestos for example or be made of india-rubber.

45 Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is:—

1. A syringe serving for injecting into the tissues automatically, slowly and gradually at the desired moment, a determined quantity of an anesthetic or
50 other liquid, characterised by the arrangement of a tightly arranged piston 22 movably attached by means of a pin to its rod, the said rod being screw-threaded over the greater part of its length and having two flat surfaces 19 covered with a scale, the said rod provided with flat surfaces being guided in a similarly shaped opening in a sleeve 15 attached to a box 5 containing the gearing devices, placed
55 perpendicularly to the longitudinal axis of the barrel 1 of the cylinder, in which the piston is moved rectilineally, the screw-threaded part of the rod gearing with

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the screw hub 10 of a helicoidal wheel that gears with an endless screw 7 mounted on a shaft 8 placed perpendicularly to the longitudinal axis of the syringe, this shaft 8 being set in rotation through its removable connection with the flexible shaft operated by a motor.

2. A syringe serving for injecting into the tissues automatically, slowly and gradually, in accordance with Claim 1, characterised by the means for connecting rotary shaft 8 of the mechanism for actuating the piston with the end A containing the rotary flexible shaft said means consisting of a sleeve 25 mounted loosely and concentrically to the shaft 8, and having formed in it an opening opposite to which the end of the flexible shaft is forced on to the shaft 8 and held thereon by the turning down of an angular piece 34 pivoted on the sleeve 25, and provided with a pin 36 that prevents an oscillating plate 30 from coming out which is firmly connected with the end of the flexible shaft and has a catch 32 encircling the circular groove 33 formed in the end of the rotary shaft 8 of the mechanism; this connection being readily detachable as described.

Dated this 27th day of November, 1913.

WHEATLEY & MACKENZIE,
40, Chancery Lane, London, W.C.,
Agents.

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